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The WHEAT STRAWWORM and ITS CONTROL

THE WHEAT STRAWWORM is distributed throughout the wheat-growing regions of the United States and ranks high in importance as an insect enemy of wheat, often destroying whole fields of spring wheat.

Two complete generations occur each year. The first generation kills outright each tiller of wheat which it infests. The second generation causes considerable loss in yield to winter wheat and kills outright the tillers of spring wheat which it attacks.

Several parasites and predacious enemies of this pest aid greatly in preventing continued losses, but can not be relied upon for complete and effective control.

The wheat strawworm attacks wheat only, and the first generation or spring form is wingless and is unable to travel great distances. It can therefore be controlled by planting wheat 65 to 75 yards from any wheat straw or stubble of the previous season. In addition to this, in the regions where spring wheat is grown, all volunteer wheat should be destroyed when this pest is abundant, to prevent reinfestation from this source.

Washington, D. C. May, 1923

THE WHEAT STRAWWORM[1] AND ITS CONTROL.

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ECONOMIC IMPORTANCE.

THROUGHOUT the wheat-growing States east of the Mississippi River the annual depredations of the wheat strawworm are ordinarily exceeded only by those of the Hessian fly[2] and the wheat jointworm,[3] and in certain areas it often exceeds either or both in destructiveness. In the wheat region of the Northwest also it is an important pest.

This insect occasions losses ranging from slight injury to total destruction of crops, depending upon its abundance. No serious outbreaks of the wheat strawworm have been recorded recently, although at present this species seems to be increasing rapidly, especially in some of the Eastern States. For this reason control measures should receive attention in order to reduce to a nominal amount the damage which may be caused by this pest.

WHEAT THE ONLY FOOD PLANT.

Unlike many important insect pests, the wheat strawworm apparently has only one food plant, namely, wheat. It has been observed to lay eggs in several other plants, such as barley, oats, rye, and several grasses, but in such cases the resulting larvæ or grubs were unable to complete their development. These facts greatly simplify the problem of control.

[1] *Harmolita grandis* Riley.
[2] *Phytophaga destructor* Say.
[3] *Harmolita tritici* Fitch.

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DISTRIBUTION.

The wheat strawworm occurs throughout the more important wheat-growing regions of the United States. The accompanying map (Fig. 1) indicates the States from which it has been re-

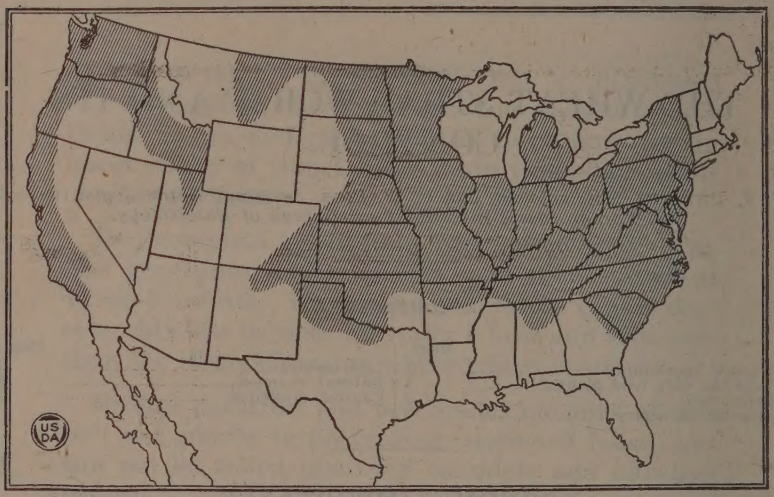

FIG. 1.—Map showing distribution of the wheat strawworm according to records of the Bureau of Entomology. The shaded area indicates the States from which occurrence has been reported.

corded by various observers of the Bureau of Entomology. There are a number of States from which no records of the occurrence of the wheat strawworm are available, but this insect probably occurs wherever wheat is grown.

FIG. 2.—Wheat strawworm: Wingless adult female of spring form. Greatly enlarged.

FIG. 3.—Wheat strawworm: Adult female of summer form. Greatly enlarged.

CHARACTER OF INJURY.

The wheat strawworm has two generations each year. The first generation is called the spring form [4] (Fig. 2) and the second generation is called the summer form [5] (Fig. 3). In the early spring the adult

[4] *Harmolita grandis*, form *minuta*.
[5] *Harmolita grandis*, form *grandis*.

or parent insect of the first generation, or spring form, deposits its eggs (Fig. 4, *a*) in or near the embryonic wheat head (Fig. 5), when the young wheat plants extend only a few inches above the surface of the ground. The larva or grub develops within and near the base of the plant, subsequently destroying the tiller or the entire plant where this has not previously tillered. Thus all tillers infested by the spring form of this pest are prevented from producing any grain and become a total loss. The results of this injury are shown by the illustration on the title page, which shows the margin of a wheat

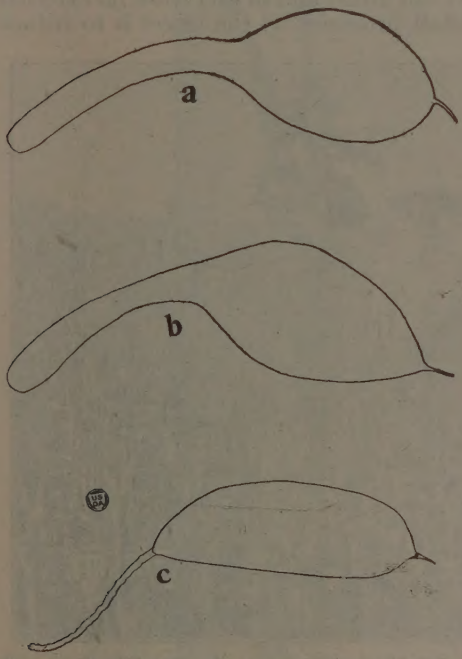

FIG. 4.—Eggs of the wheat strawworm: *a*, Spring form; *b*, *c*, summer form—*b* before oviposition and *c* just before hatching. Greatly enlarged.

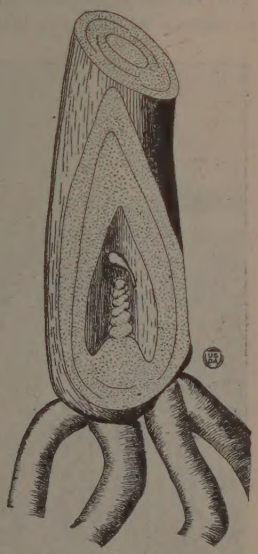

FIG. 5.—Diagrammatic drawing of young wheat plant, showing embryonic wheat head near which the eggs of the spring form of the strawworm are deposited. Note the egg within the envelope that surrounds the tender head. Slightly enlarged.

field that was very badly infested by the spring form. Figure 6, from a photograph taken on the same date, shows plants about 60 yards from the infested margin of the same field shown on the title page. Note that the plants in Figure 6 are in full head as contrasted with those on the title page.

The infested tillers resemble those which are infested with the Hessian fly in that the central shoots do not develop and the leaves have the same characteristic dark green color. As the larva or grub completes its development, the tiller usually becomes bulblike at the point of infestation (see Figs. 7 and 8), where the larva occupies a cavity formed by its eating the embryonic heads. Later it transforms to the resting stage.

The injury to wheat caused by the second generation or summer form is not so severe as that caused by the spring form, except where spring wheat is attacked, when the injury and loss are similar to that caused by the spring form in winter wheat, as previously described. The summer form deposits its eggs (Fig. 4, *b* and *c*) in winter wheat just above the youngest and most succulent joints, usually after the plant has headed and is in bloom. The larva sucks the juice of the tender plant and develops rapidly in the center of the stem (Fig. 11), or sometimes in the walls of the stem before the straw has hardened. The stems of winter wheat are not killed and in fact show no external evidence of injury, but the effect produced by the insect is to reduce

FIG. 6.—Normal wheat uninfested by the wheat strawworm. Compare this wheat with the infested wheat 60 yards away, shown on the title page. The two photographs were taken on the same day.

the yield of grain both in weight and in quality. This has been demonstrated clearly by collecting all the stems from a given area, separating the infested from the uninfested stems, and weighing the grain from each lot. The results of such weighings showed an average loss as high as 22 per cent, caused by the wheat strawworm. Where the yield of grain was estimated from heads of the same size collected from infested and uninfested stems, an average loss of 7 per cent was found.

LIFE HISTORY.

The two generations of the wheat strawworm are designated as the spring form and the summer form, respectively, because of the fact that even though these forms comprise individuals of the same species, they do not resemble each other very closely. Each of these

forms has four stages, namely, the adult or parent insect, the egg, the larva or grub, and the pupa or resting stage.

The adults of the spring form (Fig. 2) are minute, shiny black insects, closely resembling ants, and usually are without wings, or if wings be present they rarely are fully developed. The legs have light yellowish bands at the knees. In this form of the insect the winter is passed as a pupa (Fig. 12) in the wheat stubble or straw of the previous season. The adult of the spring form, which is practi-

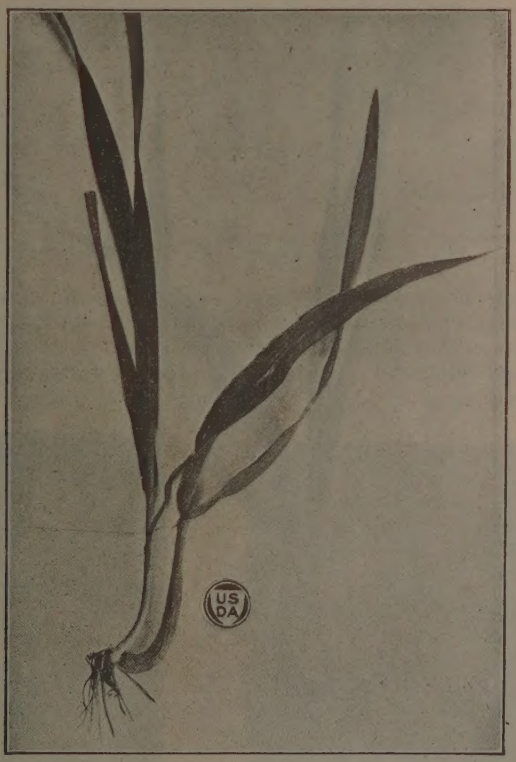

FIG. 7.—Young wheat plant showing healthy tiller at left, the tiller at right infested by the spring form of the wheat strawworm. Note the absence of the central shoot and the bulblike appearance of the infested culm near the base. About natural size.

cally always a female, emerges in March and April in the Eastern and Central States, while in Washington State emergence occurs in April, and in Arizona it takes place during the latter part of January and continues through February. The females of this generation deposit their eggs in young wheat plants, in or very near the embryonic wheat head (Fig. 5). The egg (Fig. 4, *a*) is white and nearly transparent, pear-shaped, and has a short, thick pedicel which is slightly curved. In about 10 days the larva hatches from the egg and totally destroys the embryonic head within the plant, usually causing a slight enlargement of the stem (Figs. 7 and 8) at the point

of infestation. The cavity thus formed in the crown of the plant is occupied by the larva (Fig. 9) after it has completed its feeding. This larva becomes more robust than those of the summer form, perhaps because it feeds on the most nutritious part of the plant. It is of a light straw color, has brown jaws, and when full-grown is 0.17 inch (4.5 millimeters) long. Full growth is reached in about 27 days and the pupa or resting stage then begins (Fig. 10). At first the pupa is the same color as the larva, but later changes to a shiny jet black.

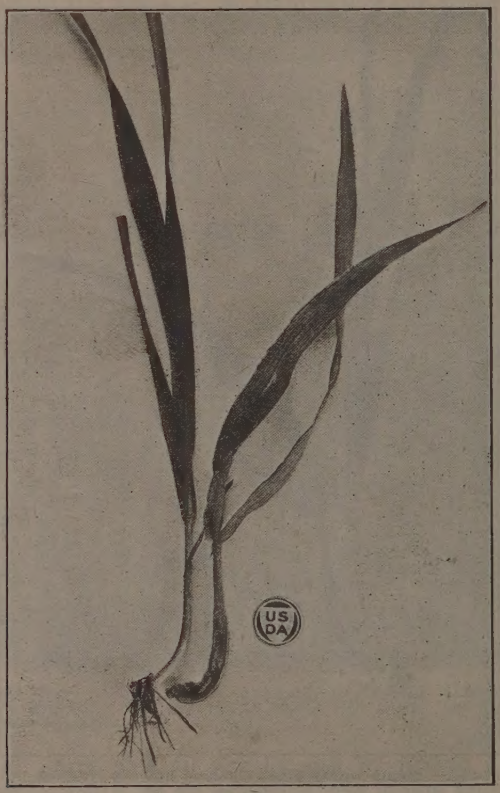

FIG. 8.—Same plant as shown in Figure 7, the infested tiller being split to show the wheat strawworm in the cavity it has formed by eating the embryonic wheat head. About natural size.

The pupa stage requires about 12 days, after which the fully developed adult of the summer form gnaws circular holes through the walls of the stem and comes out.

The adults of the summer form (Fig. 3) are much larger and more vigorous than those of the spring form. They have fully developed wings which they use to great advantage in dispersing throughout fields adjacent to their place of development. Apparently they are strong flyers and with the aid of favorable winds have been found to fly to fields at considerable distances from where they originated.

No males have been found among the adults of the summer form, and the females reproduce without mating. They emerge in May and June over most of the wheat-growing region, and deposit eggs (Fig. 4, *b* and *c*) singly in the growing wheat plants slightly above the joints, about the time winter wheat is coming into bloom. The

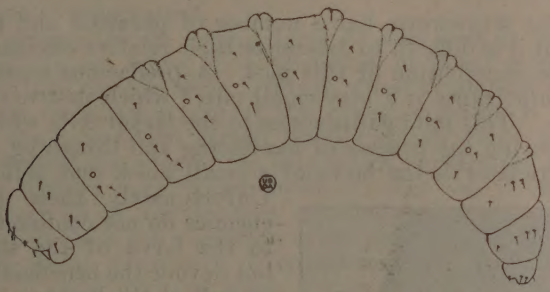

FIG. 9.—Full-grown larva of the spring form of the wheat strawworm. Greatly enlarged.

two upper joints are usually preferred for oviposition, though every joint may be infested. Often the eggs are placed directly in the cavity of the stem or culm, but may be placed in the walls of the stem. The eggs hatch in from 5 to 5½ days. Normally but one larva is found at a joint. Where more than one larva is present one usu-

FIG. 10.—Pupa from which emerges the adult of the summer form of the wheat strawworm in the tiller of a young plant where it developed. Greatly enlarged.

FIG. 11.—Full-grown larva of summer form of the wheat strawworm in its cell in the center of the wheat stem.

ally may be found in the center of the stem, just above the joint, and others in the walls. The larvæ lacerate the inner walls of the stems, where they suck the rich plant juices and develop rapidly, because they must attain full growth before the plant tissues have hardened. The full-grown larvæ of the summer form resemble in color those of the spring form and are long and slender and not so robust. They form neat cells within or near the joints (Fig. 11) and remain there

to enter the pupa or resting stage (Fig. 12) in the fall. No change occurs until early spring, when they develop to adults of the spring form and gnaw their way out to continue their life cycle.

NATURAL ENEMIES.

The wheat strawworm has a number of parasitic and predacious enemies, but it is difficult to determine their relative efficiency because of the wide distribution of this pest. A predacious enemy of considerable importance is a very small mite [6] which destroys the larva in the stem. This mite gains access to the larval cells which become ruptured during the process of harvesting and thrashing. Another reported predator is the larva of a small black and yellow beetle.[7] Unfortunately these predacious enemies do not confine themselves to the larva of the strawworm, but devour the beneficial parasites as well as the host.

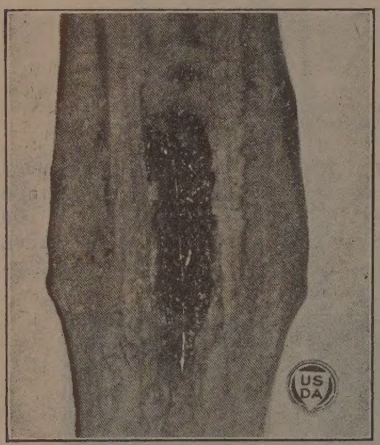

FIG. 12.—Pupa from which emerges the adult of the spring form of the wheat strawworm in its cell in old wheat straw. Note how each end of the cell is plugged with frass. The winter is passed in this stage.

Of the several parasites of the wheat strawworm, one of the most important is known scientifically as *Eupelmus allynii* French. Wheat stems collected in Virginia as early as June 21, in 1921, showed by dissection as high as 22 per cent of the stems parasitized by this species. This parasite is a small, slender, four-winged wasp with a somewhat brilliant greenish-black body and yellow legs. In the southern half of the United States it has as many as four or more generations each year.

Three parasites of importance [8] and similar in appearance have yellow abdomens and metallic-colored bodies. Each of these parasites has two or more generations each year.

Another parasite of importance [9] has five generations each year in the southern half of the United States. This species in the adult stage is bluish-black and in its life history is very similar to the parasites previously mentioned, except for the greater number of generations.

All of the parasites mentioned are minute four-winged wasps in the adult or parent stage and are about the same size as the adult of the strawworm. Unfortunately, when unassisted they can not be depended upon to control the wheat strawworm.

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[6] *Pediculoides ventricosus* Newp.
[7] *Leptotrachelus dorsalis* Fab.
[8] *Ditropinotus aureoviridis* Crawford, *Merisus febriculosus* Girault, and *Eridontomerus isosomatis* Crawford.
[9] *Homoporus chalcidiphagus* Walsh.

CONTROL MEASURES.

The parasites and predacious enemies of the wheat strawworm are important factors in preventing continued serious losses which this pest might cause. Without these enemies of this pest, growing wheat for profit would be difficult unless effective methods of control were practiced to some extent.

The first generation or spring form of this pest is practically wingless and can not travel great distances to infest young wheat and thus continue the life cycle. Where wheat is planted adjoining wheat stubble or straw stacks of the previous season it has been found that the infestation caused by the spring form is greatest within 30 yards of the edge of the field which borders the old wheat straw. The writers have found, however, that the infestation at times may reach twice this distance, especially where the prevailing winds are favorable to the migration of the pest.

Where the wheat strawworm is troublesome an effective control, therefore, is to avoid growing wheat within 65 to 75 yards of wheat straw of the previous season.

In Virginia it has been found that wheat can safely follow wheat on the same land if all stubble is plowed under after harvest and the land sown to cowpeas, which in turn are disked into the soil in time to sow the wheat in the fall.

In regions where spring wheat is grown to the exclusion of winter wheat, volunteer plants furnish the only places in which the adults of the spring or wingless form, developing from pupæ overwintering in wheat straw or stubble of the previous year, can lay their eggs, the egg-laying period of this generation being finished before any spring-sown wheat is up. From these volunteer plants, therefore, if not destroyed, emerge the adults of the second generation or winged form, which, laying their eggs in the spring wheat, may cause considerable loss to the crop.

In localities where the wheat strawworm is injurious, wheat should not be top-dressed with manure containing unrotted straw which is infested by this species.

Straw stacks are a greater source of infestation to growing wheat by the wheat strawworm than is usually supposed. In communities where this pest is very abundant, volunteer wheat around the straw stacks should be destroyed by early spring before the first generation has developed.

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